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Caltrans Division of Research, Innovation and System Information

Research Results

Evaluating the Performance of Rubberized Warm Asphalt Mixes

RWMA technology uses less energy, improves working conditions, and extends paving opportunities

Pavement

DECEMBER 2013

Project Title:
Laboratory and Accelerated Pavement Testing (APT) of Gap-Graded Rubberized Mixes (Hot Mix Asphalt and Warm Mix Asphalt) for the Department of Resources Recycling and Recovery (CalRecycle)

Task Number: 2385

Start Date: May 17, 2011

Completion Date: May 15, 2013

Product Category: Evaluation of new commercial products to determine if they meet Caltrans' need and improved processes

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WHAT WAS THE NEED?

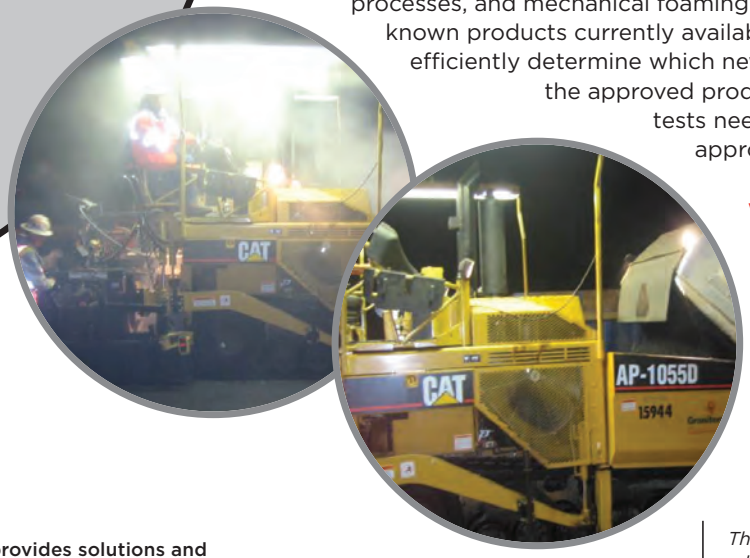
Rubberized, hot mix asphalt (RHMA) is commonly used for pavement construction for its durability and noise reduction. However, producing RHMA requires high temperatures and a high-emission, energy-intensive process. It also cannot be applied during cold weather, limiting the paving season.

The development of rubberized, warm mix asphalt (RWMA) addresses some of the shortcomings of RHMA and provides several benefits, including less smoke emissions and the ability to sustain longer hauls and be used in cool weather. But it was not known whether RWMA performs as well as RHMA in terms of its resistance to rutting and cracking. The level of air quality improvement also needed to be quantified to ensure that they meet the standards set in restricted areas.

New WMA technologies are still being introduced. Currently, four WMA categories exist—organic additives, inorganic additives, chemical foaming processes, and mechanical foaming processes—with more than 20 known products currently available in the United States. To more efficiently determine which new technologies Caltrans can add to the approved product list, new simplified laboratory tests need to be developed and the appropriate criteria identified.

WHAT WAS OUR GOAL?

The goal of this research was to evaluate the rutting and fatigue cracking resistance of RWMA and quantify the air quality improvements that the technology offers.



The hot mix (left) generates smoke emissions, while the warm mix (right) exposes workers to less fumes and heat.

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WHAT DID WE DO?

Caltrans, in partnership with the University of California Pavement Research Center (UCPRC), tested and compared the rutting resistance of both RWMA and RHMA using a Heavy Vehicle Simulator (HVS). The HVS tests were then correlated to less costly laboratory tests that are being developed as a means to evaluate future RWMA products. Lab tests were used to assess the fatigue resistance of both types of mixes.

To measure air quality, the team used both field testing and laboratory testing. The field testing involved a novel method of applying a canopy over the just-dumped asphalt mix and extracting the air samples over time. The researchers developed a laboratory test method that simulated the mixing of the asphalt in the plant production. The gases were extracted and examined in an environmental laboratory.

To test the noise level reduction and duration, rubberized sections were extracted from a previous pavement noise study and evaluated.

Paving with RHMA (left); working with RWMA (right)

WHAT WAS THE OUTCOME?

The rutting resistance of the RWMA mixes tested was similar to RHMA. Under HVS testing, RWMA initially showed slightly faster rutting, but within a few weeks the behavior was essentially the same as RHMA.

The fatigue characteristics between RHMA and RWMA were basically the same, but RWMA offers the benefit that high compaction can be achieved at lower temperatures. Higher compaction results in a longer fatigue life.

The air quality studies indicated that RWMA mixes produce less noxious gases than RHMA due to the lower production and placement temperatures. In addition, during the construction of the test sections, it was discovered that RWMA mixes are more workable on the job site than the RHMA mixes. RHMA mixes are very stiff and do not allow for much adjustment after the mat has been put down.

WHAT IS THE BENEFIT?

RWMA mixes perform as well as or better than hot mixes, and offer additional productivity and environmental benefits. RWMA can withstand longer hauls, so production plants can be more centralized. Its workability at lower temperatures allows for paving in cool weather, extending the work season. Workers are also exposed to less fumes and heat. The air quality improvements also allow rubberized mixes to be used in cities and areas with restrictions on emissions.

LEARN MORE

To view the complete report:
www.ucprc.ucdavis.edu/pdf/UCPRC-SR-2013-03.pdf

Testing hot mix and warm mix asphalt pavements